2. DESCRIPTION

This chapter describes the natural features of the service area, the history of the utility from incorporation of the city in 1906 to current ownership by Lewis County, and the facilities of the utility.

2.1 NATURAL FEATURES

The supply source for the utility is the Cowlitz River. The headwaters of the Cowlitz River originate off the east side of Mt Rainier and surrounding mountains. Although the source and intake for the utility are outside the service area limits, the general descriptions of the natural features of the service area are provided to help understand and plan for maintenance and new construction projects. Various natural features are discussed in this section: geography; climate and precipitation; and geology.

2.1.1 Geography

The service area is located on a gently rolling hill that slopes from the northeast to the southwest bordered by the Cowlitz River to the east and by Olequa Creek (a tributary to the Cowlitz River) to the west and south. The UGA portion of the service area slopes from the north to the south toward Olequa Creek. Elevations range from about 90 ft (NGVD 1929) near the Cowlitz River to 280 ft in the northeast section of the service area. SR 506 runs east to west through the middle of the RSA.

2.1.2 Climate and Precipitation

On average, the area has the same climate as that of the greater Puget Sound region since there are no significant natural topographic barriers affecting Lewis County from the rest of the Sound. Most of the region's rainfall occurs during the colder months, between October and April, in conjunction with the frequent passage of low pressure systems (storm systems) through the area. Winter temperatures typically range from 35 to 45 degrees F with freezing temperatures from 50 to 80 nights per year. The region is free of frost about 160 days a year. The influx of storm systems during the fall and winter months also present the area with significantly higher winds due to the intense nature of low pressure systems. The region's highest occurrence of cloud cover is also during the fall and winter months because of the increased number of low pressure systems and precipitation activity.

The warmer months, May through September, experience significantly less rainfall due to the fact that the main jet stream that prevails over the Pacific Northwest during the colder months shifts its position to the north, and takes much of the precipitation along with it. Temperatures typically range from 70 to 80 degrees F.

The area receives an average of 81 inches of rainfall per year with almost 50 percent occurring in the period between November and January. December is historically the wettest month, and July the driest.

2.1.3 Soils and Geology

The underlying geology of western Lewis County is predominately sedimentary and igneous rock approximately 10,000 ft deep. The area has been subject to recent flood deposits of gravel, sand and silt along Olequa Creek and its tributaries. Older landslide deposits exist east of the City along the slopes that form the eastside of the Grand Prairie. These landslide deposits extend up the Lacamas Creek valley, within Drews Prairie, near the water supply source from the Cowlitz River.

There are primarily three soil series in the service area: mostly Olequa with smaller areas of Lacamas and Klaber. The Olequa series consist of deep, well drained soils on stream terraces. The latter soil series consist of very deep, poorly drained soils.

2.2 HISTORY OF THE SYSTEM

Lewis County was established in 1845 and situated in southwest Washington. The City was incorporated in 1906 in Lewis County.

The first water source for the City was a small creek located on a hill southwest of the town. A wood stave transmission line brought the water by gravity from the original reservoir to customers. Several small wells located near the site of the current wastewater treatment plant (WWTP) were used in the 1940s but have been since been abandoned. Due to contamination of the creek and periodic breakages of the wood stave line, the creek supply source and transmission line were replaced in 1963 with an intake and pump station on the Cowlitz River.

In 1963, the new facilities consisted of an intake and pump station on the Cowlitz River situated east of city limits, a water filtration plant, one 60,000-gallon reservoir and 8-inch transmission main from the plant to Main Street. The plant and reservoir were at the site of the current plant. The intake consisted of 170 ft of perforated pipe buried below the river and a raw water (RW) pumping chamber located adjacent to the riverbank. Water was pumped up to the plant, treated, stored in the reservoir and distributed throughout the system.

In 1973, the Enchanted Valley Country Club (EVCC) was established of residential and recreational camp lots. The EVCC development is adjacent to the City and governed by a home owners association (HOA). The EVCC water system consisted of five shallow wells, a 50,000-gallon redwood tank, a pump house and several thousand feet of distribution main.

In 1978, EVCC made an agreement with the City for emergency water supply by way of a 2-inch intertie with the Vader water system. The EVCC system was eventually determined to be inadequate after several episodes of low water quantity and poor water quality. The EVCC approved an agreement with the City for wholesale purchase of water in 1980.

In 1979, several upgrades were made to the water treatment system. These improvements included constructing a 250,000-gallon steel reservoir; upgrading the water treatment plant with chemical additions; and increasing filtration capacity to 150 gpm. The existing 60,000-gallon reservoir was converted to a clearwell. The intake structure was also rebuilt in 1979 after a landslide and high water destroyed the original structure.

In 1980, the City expanded its agreement with EVCC from emergency water supply to a year-round water supply for domestic use. The agreement for wholesale water purchase was renewed in 1995 and extended through 2015.

In 1983, land movement and high water damaged the intake facility again. Modifications were made to provide water at their sole source. The system consisted of a submersible pump set directly in the river which pumped water through a 4-inch fire hose to a small wet well. The wet well is located next to the abandoned RW well and intake system. Pumps located at the wet well then pump water up to the Plant.

In 1990, a 10-inch transmission main was installed from the plant to 6th Street. Many of the small 2-inch and 4-inch distribution mains were replaced with larger pipes to improve fire flow. About 5,000 lf of 8-inch and 6-inch lines were constructed in the old downtown area, and an 8-inch line was constructed in the southeast part of the city to improve pressure during high demand periods.

In 1993, polymer baffle curtains were installed in the clearwell to increase disinfection contact time and the 2-inch line to EVCC was replaced with a 6-inch line.

In 1995, several elements of the intake facility were damaged. The transmission of RW to the plant was interrupted when a section of the RW transmission main broke in a landslide in July 1995. Then the temporary submersible pump set in the river failed in August 1995. Fortunately enough stored water was available in both cases so that the system was never completely out of water.

In November 1995, the transmission pumps located adjacent to the river were damaged by flooding of the Cowlitz River. The pumps were out of commission for one week. Storage was depleted in two days and water was trucked from the City of Winlock for one week. The pumps and electrical systems at the intake facility were rebuilt and restored to functional order.

In 2002, the plant was replaced with a new, dual train Microfloc rapid sand filtration system with an adsorption clarifier and a filter backwash treatment system. The new plant uses alum, polymer and soda ash pre-filtration chemical feed systems, and sodium hypochlorite post-filtration chemical feed system. The filter backwash treatment system consists of two asphalt-lined backwash settling basins.

At the same time of these plant improvements in 2002, improvements were made on the raw water intake and pumping system. The top of the wet well was raised 1.5 ft, a new building was constructed over the wet well, and three new vertical turbine pumps were installed in the wet well building. The new river intake system consists of a valve vault on the shore with an 8-inch HDPE line extending underground into the river with a tee on the end. Stainless steel expanded metal screens were constructed over the two openings of the tee. A submersible pump is inserted into the 8-inch HDPE conduit line with a 4-inch flexible hose so the pump can be easily removed for servicing. The submersible pump in the 8-inch HDPE pumps water through the 4-inch hose to the wet well. The vertical pumps in the wet well building then pump the water to the treatment plant.

Sometime afterwards in 2002, one of the expanded metal screens on the intake tee was replaced with a larger, more elaborate screen because the screens kept plugging.

In 2004, the intake screen was again replaced with a Johnson wire-wound stainless steel screen and modified with an air compressor and one-inch air line. These modifications were made to provide air scour cleaning of the screen.

In 2006, the City replaced 1,000 ft of aging 4-inch water main along 9th Street, A Street and 10th Street with a new 8-inch main and service lines.

In January 2009, the Cowlitz River flooded and damaged one intake pump and the lower portion of the gravel access road to the intake facility. In July 2010, the damaged intake pump was repaired and installed, and gravel was placed in the eroded section of the road at the foot of the hill using FEMA funding to the City.

In 2009, the EVCC HOA was dissolved in October 2008 and the City purchased the EVCC water system in June 2009. At the time, the EVCC system was a Group A community public water established in February 1980 for 107 approved connections and known as PWS #23390Y. Problems with their shallow groundwater wells necessitated the emergency water purchase from the City in 1978 with approved wholesale purchase of water in June 1980.

In late 2009, the City met with DOH and Lewis County to determine options to get the system into compliance. A run of 16 main breaks from 2006 to 2010 placed the City on ten boil water advisories issued by DOH. Then the City faced a budget deficit in 2010, was under investigation by the State Auditor, and because of current debt and poor credit rating was unable to financially and managerially operate the water system. In order to continue to operate the water system and be in compliance, the City voluntarily placed a moratorium on new city water and wastewater connections. DOH, the City and Lewis County met to explore options and found that the best solution was to appoint Lewis County receiver of the public water system (PWS).

On October 14, 2010, DOH formally approved and merged the EVCC system into the City system in anticipation of the court receivership. The Vader-Enchanted Valley water system is a Group A community water system known as PWS #90900E and approved in 2010 for 369 connections by DOH.

It is unclear when specific elements of the EVCC water system were abandoned, but we know at the time of DOH approval in October 2010: the redwood tank was dismantled, the pump house was inoperative, and all wells were disconnected from the system. Some pertinent sections from the 1994 WSP for the EVCC were:

> "It is recommended the Country Club transfer the ownership for the wells and associated water rights to property owners or abandon the wells in accordance with DOE guidelines."

"...one or two of the wells are presently being used as private wells for sprinkling; however no cross connections were observed. The existing booster pump station is still connected to the system and separated by a closed valve."

There is an absence of documentation from the EVCC and City pertaining to the five wells. Anecdotes hint at destruction and removal of documents during a contentious period in mid-2000. As an effort to find closure, Lewis County requested an information search from State Department of Ecology (Ecology) about the EVCC wells to determine if the wells were abandoned with Ecology guidelines and the status of these wells' water rights. Lewis County also researched Ecology's well log database. No information was found.

On October 29, 2010, Superior Court awarded the water system to Lewis County with the plan to have transitional operation and management by Lewis County immediately, full operation and management by Lewis County on January 1, 2011; and transfer of assets to Lewis County by October 2011.

On January 1, 2011, Lewis County began full operation and management of the water system.

In 2012, Lewis County replaced 6,700 lf of brittle asbestos concrete (AC) lines with 8-inch PVC mains complete with gate valves and combination air release and vacuum valve assemblies; constructed 1,940 lf of new HDPE transmission line to replace an AC transmission line; constructed four sampling stations; and 77 new service connections complete with new meters and customer shutoff valves. Many of the new main replacements and associated work were identified as capital improvement projects in the 2010 WSP Amendment (TR-2, TR-3, D-2, D-3, D-4, D-5, D-6, D-9, D-10, M-2).

In 2013, Lewis County contracted for a diver inspection of the clearwell and 250,000-gallon steel tank, and reviewed the status of the remaining CIP projects in the 2010 WSP Amendment. The reservoir inspection was CIP project ST-1. Project D-1was deemed not immediate as the State Department of Transportation decided to monitor the existing pipe supports instead of new, flexible pipe supports (May 2007). Project TR-1 is replacement of two drain grates in the plant. We believe this was completed by the City as the drain grates in the plant at the time of receivership was in adequate condition. A tabulation of the status of the CIP projects listed in the 2010 WSP Amendment is in Chapter 10.

In February 2014, the agreement to transfer the assets of the water system from the City to Lewis County was approved after communication was clarified between the City mayor and councilmembers. Conditions for resumption of the system by the City were also in the agreement. County ownership of the system complete with water right, facilities, land and easements was effective on April 30, 2014.

2.3 SYSTEM FACILITIES

Descriptions of the water system facilities owned and managed by Lewis County are provided in this section. A water system map is provided as Figure 2.1.

2.3.1 Supply Source

The supply source is the Cowlitz River. The intake system consists of a screened intake with an air scour cleaning system, a submersible pump and a 4-inch flexible pipe that discharges to a small wet well. A vertical turbine pump draws water from the wet well to the Plant using a dedicated transmission main. The transmission main traverses an area that is extremely susceptible to landslides as described in Section 2.2.

The system has one water right for surface water diversion from the Cowlitz River for municipal use. Maximum instantaneous flow is 0.50 cfs or about 224 gpm. The original priority date of the water right is November 9, 1961. A maximum annual volume is not specified. The point of withdrawal along the Cowlitz River was changed in 1972 which changed the priority date to November 11, 1972. Unlike currently issued water rights, those issued in the 1960s to 1970s commonly did not have an annual withdrawal amount. A copy of the water rights certificate #9616 is in Appendix C.

2.3.2 Intake Facilities

The raw water intake consists of a 8-inch HDPE line that runs approximately 20 ft from the river bank and terminates in a 10-inch tee with stainless steel 1/8-inch screens that are back flushed with compressed air. The air line runs from a compressor in the pump station building to allow the operator to back flush the screens. Problems exist with sediment collecting in the intake pipeline. The river pump conveys approximately 200 gpm into the clearwell of the raw water pump station, and is controlled by two floats located in the clearwell. Unless the screen becomes plugged, the average operation for the river pump when the Plant calls for water is 15 minutes on and 45 minutes off.

The raw water pump station consists of three vertical turbine pumps. The pumps are called by the water level in the 250,000 gallon reservoir. With one pump operating, 190 gpm of raw water can be conveyed to the Plant. Two pumps can deliver in excess of 225 gmp. Design criteria for the raw water intake and pump station are presented in Table 2.1.

TABLE 2.1 – RAW WATER PUMP STATION DESIGN CRITERIA

	Quantity	Type	Motor Size	Capacity
River Pump	1	4-inch submersible Crown well pump	3 hp	200 gpm
Pump Station	3	Crown vertical turbine pump	25 hp	190 gpm per pump

Improvements to the intake facility were made immediately in the winter season following the October 2010 court order of receivership. New locks were installed on the gates at SR 506 and at the water treatment plant. The gate and fencing at the intake pump house were secured.

Other improvements made at the intake facility were:

- Constructed a new baffle in the intake clearwell in 2012.
- Installed new seals and bearings on intake pumps #1 and #3 in 2014.
- Purchased new seals and bearings for pump #2.

- Rebuilt intake pump #1. (New pump shaft as years of misalignment had caused asymmetrical wear of the shaft.)
- Reconstructed access road.
- Cleared vegetation along access road, entrance gate and pump house.
- Installed new signage at the entrance gate.

The City of Vader had intake pump #3 rebuilt in July 2010. The work was performed by PumpTech, Inc, Bellevue, WA.

The raw water transmission line delivers water from the raw water (RW) pump station to the Plant via a single 4-inch HDPE water line up to SR 506, along SR 506 until heading up the hill to a valve group just below the plant. The line then transitions to C-900 pipe and runs to the plant. The improvement to C-900 was completed in 2016 and corrects an inherent weakness in the system. In 2012, a new segment of HDPE transmission line was constructed and placed immediately in use. The AC segment from the intake structure to SR 506 is isolated from use but is intact as a backup transmission line.

2.3.3 Water Treatment Plant

The filtration system uses two 100 gpm capacity units consisting of an adsorption clarifier followed by a mixed media filter. The dual filter design allows the plant to continue filtering water while one filter undergoes backwashing. The backwash basins are designed to operate in parallel to allow one basin to be taken out of service for cleaning. Design criteria for the treatment plant are provided in Table 2.2.

TABLE 2.2 – TREATMENT PLANT DESIGN CRITERIA

	TOTAL AREA		UPFLOW RATE		BACKWASH RATE	
Adsorption Clarifier	10 sf/unit		10 gpm/sf			
Mixed Media Filter	20 sf/unit		5 gpm/sf		150 gpm/ft @ 60° F	
	NUMBER		TYPE		MOTOR SIZE	
Filtered Pump	2		End suction close coupled		3 hp	
Backwash Pump	1		Vertical turbine		10 hp	
Air Scouring Blower	1		Regenerative		3 hp	
CHEMICAL FEED SYSTEM	TANK VOLUME	TANK DIMENSIONS	PUMP TYPE	QTY OF PUMPS	CAPACITY	MIXER MOTOR SIZE
Alum coagulant	150 gal	32"Dx47"H	Positive Displacement Diaphragm	2	108 gpd	¼ hp
Caustic soda ash	150 gal	32"Dx47"H		2	108 gpd	¼ hp
Polymer	100 gal	30"Dx38"H		2	60 gpd	1/3 hp

Alum is used as a coagulant and polymer as a filter aid. Soda ash is used to offset the pH depression caused by the alum. Both the alum and soda ash are injected in the pumped RW line ahead of the static mixer and prior to filtration. A small amount of polymer is injected after the static mixer upstream of the adsorption clarifier. Following injection, the finished water (FW) is sent to a clearwell. Sodium hypochlorite is injected in the FW line prior to the clearwell. The clearwell and 250,000-gallon reservoir are used to provide contact time for the disinfectant. Turbidity is measured in the RW upstream of the first chemical injection points as well as on the FW from each filtration unit. Chlorine residual is measured using a chlorine residual analyzer. All chemical feed systems are controlled by a programmable logic controller (PLC) based on flow into the Plant. Backwash is also controlled by the PLC through monitoring the liquid level above the filter media. The polymer feed is currently not programmed to operate based on plant flow.

The Plant monitors the volume of RW pumped to the Plant from the intake facility, of FW used to backwash treatment filters, and of FW sent to the distribution system. These meters are housed at the Plant.

Lewis County made several maintenance improvements to the plant building immediately after the day of receivership. The following actions were made:

- Placed new locks in the office, plant and gate.
- Installed new heaters in the office and in the plant.
- Repaired and sealed exposures and breaks of the building exterior.
- Replaced interior and exterior lighting with new energy efficient lighting.
- Cleared grounds of vegetation, debris and old material stockpiles.
- Created and organized material inventory.
- Constructed new roofs for the plant and detached storage shed.
- Erected new porch.
- Posted new signage at the plant gate.
- Leased portable toilet facility.
- Established regular garbage service.

2.3.4 Storage

The system has a 250,000-gallon covered steel reservoir which was constructed in 1979. The ground level type reservoir is located next to the Plant with a base elevation of 315 ft, an overflow elevation of 329 ft and a diameter of 55 ft.

Additional storage is provided by the old reservoir under the Plant building which is now used as a 60,000-gallon clearwell. The clearwell is used to provide contact time for adequate chlorine residual in the distribution system.

2.3.5 Distribution System

The current transmission mains from the Plant are a 10-inch main to 6th Street, and a 6-inch line to EVCC. The distribution system is made up of pipes ranging from 2-inch to 10-inch pipes, and of PVC, HDPE, AC and ductile iron (DIP) materials. Generally, the 2- through 4-inch pipes were installed in 1979; and the 6- through 8-inch pipes were installed in 1990 to increase system

pressure for emergencies. Lewis County replaced 2-inch plastic, 4-inch AC and 6-inch AC lines with 8-inch PVC pipes in 2012. Wherever possible, the 2012 improvements looped the distribution system and installed blow off assemblies at the downstream ends. The 2012 improvements also connected the distribution lines in the City and EVCC. A tabulation of total lengths and sizes of water mains are summarized in Table 2.3.

TABLE 2.3 – DISTRIBUTION SYSTEM PIPE INVENTORY

DIAMETER (inches)	PIPE MATERIAL	LENGTH (ft)
10	PVC	4,466
	DIP	50
8	PVC	16,834
	DIP	116
6	PVC	11,989
	AC	6,726
	DIP	39
4	PVC/HDPE	6,957
	HDPE (transmission line)	3,796
	AC (transmission line, isolated)	1,974
2	PVC	10,684
	TOTAL	63,631 ≈ 63,630

AC Asbestos Cement
DIP Ductile Iron Pipe
HDPE Hard Density Polyethylene
PVC Polyvinyl Chloride

The RW transmission line from the intake to the Plant is a 4-inch line: PVC from the intake to SR 506 and AC from SR 506 to the Plant. In 2012, the AC line was replaced with a 4-inch HDPE; but the AC line was left intact and isolated (valved) from use.

2.3.6 Service Meters

There are meters for all services in the system. Service meters were installed for the local WWTP in 2011 and for the local fire service in 2012. Prior to 2011, the system was metered using about nine different brands of meters. Meters in the city read in gallons and meters in EVCC read in cubic feet. Meters were replaced for the entire system in 2015 to read in gallons.

2.3.7 Pressure Zones

The system operates entirely on one pressure zone with no pressure reduced and no boosted pressure zones.

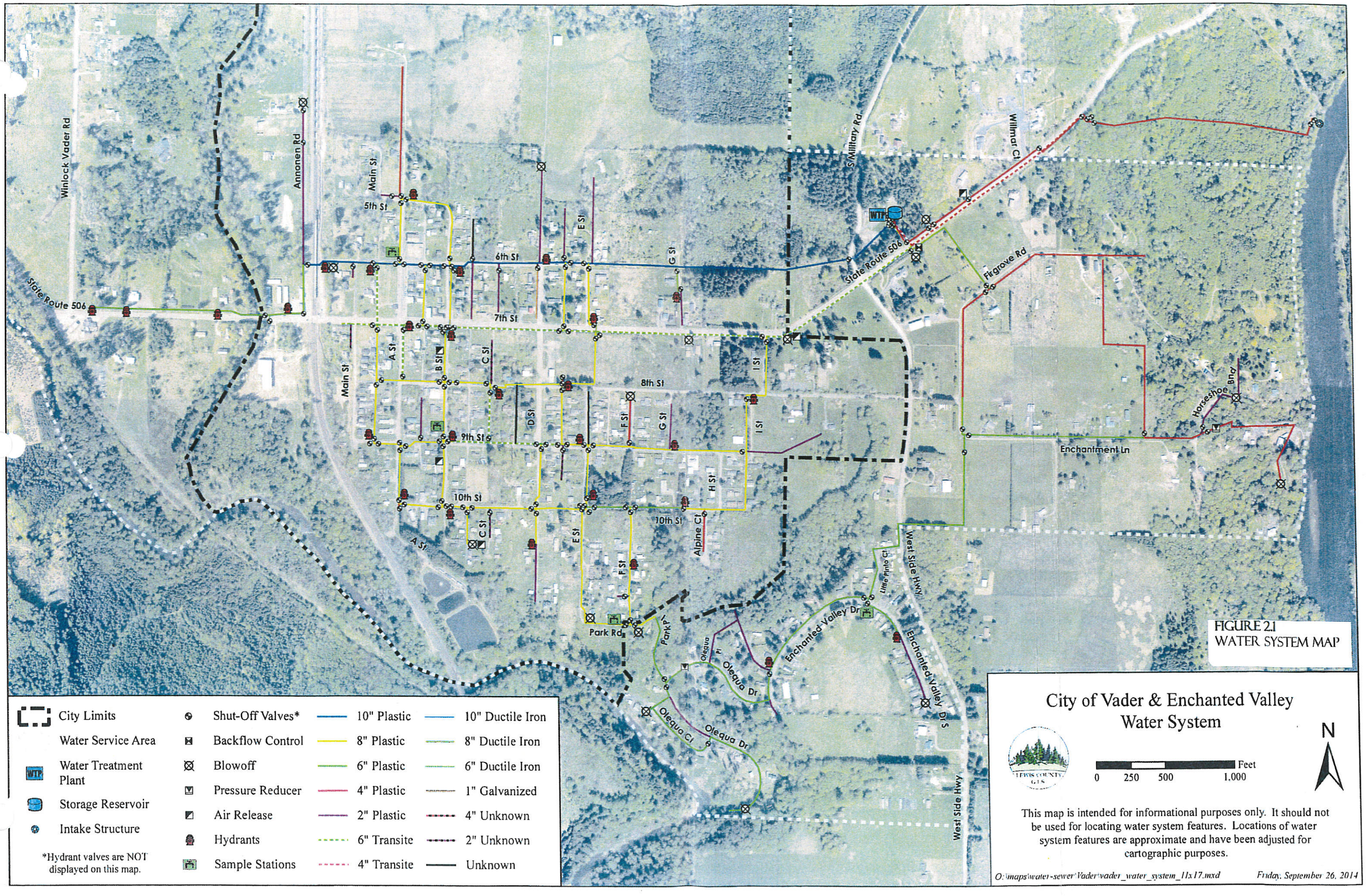

FIGURE 2.1
WATER SYSTEM MAP

City of Vader & Enchanted Valley Water System

LEWIS COUNTY GIS

0 250 500 1,000 Feet

N

This map is intended for informational purposes only. It should not be used for locating water system features. Locations of water system features are approximate and have been adjusted for cartographic purposes.

O:\maps\water-sewer\Vader\vader_water_system_11x17.mxd Friday, September 26, 2014